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Attorney Docket No.	81045.943
First Inventor or Application Identifier	MOHAN ANANDA
Title	METHOD AND APPARATUS FOR SECURE DATA STORAGE...
Express Mail Label No.	EL582495180US

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

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1. [ ] * Fee Transmittal Form *(e.g., PTO/SB/17)*
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2. [✔] Specification [Total Pages 36]
(preferred arrangement set forth below)
- Descriptive title of the Invention
- Cross References to Related Applications
- Statement Regarding Fed sponsored R & D
- Reference to Microfiche Appendix
- Background of the Invention
- Brief Summary of the Invention
- Brief Description of the Drawings *(if filed)*
- Detailed Description
- Claim(s)
- Abstract of the Disclosure

3. [✔] Drawing(s) *(35 U.S.C. 113)* [Total Sheets 8]
4. Oath or Declaration [Total Pages]
   a. [ ] Newly executed (original or copy)
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7. [ ] Assignment Papers (cover sheet & document(s))
8. [ ] 37 C.F.R.§3.73(b) Statement *(when there is an assignee)* [ ] Power of Attorney
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81045.943

UNITED STATES PATENT APPLICATION

FOR

METHOD AND APPARATUS FOR SECURE DATA STORAGE AND RETRIEVAL

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BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

This invention relates in general to the field of data security, and more particularly to data encoding/decoding in a network.

2. BACKGROUND ART

Data security is of extreme importance to all entities utilizing data processing and computing systems. As such, various data security systems are utilized to prevent unauthorized access to stored digital information. Generally, data is stored either in a central facility in a network environment, or in local computer systems' storage in a distributed environment. In either case extreme care is required to protect the data from access by intruders. Unauthorized access to the stored data can be initiated from external sources as well as internal sources without authorization to access the data, leading to copying or loss of valuable data.

With the proliferation of easily accessible networks such as the Internet, the security threat becomes much more serious to said entities as many of their computers can be accessed by outside computers through the Internet. There are sophisticated "firewall" systems that can detect any unauthorized attempt of intrusion to a particular computing system or a network of computers, and attempt to prevent unauthorized entry into the computing system. However, in many instances unauthorized intrusion into secured computing systems

takes place despite the firewall systems, and valuable information lost or stolen from the computing systems.

Therefore, there have been attempts at developing systems that virtually eliminate any loss of information even in case of unauthorized intrusion into a computing system. One such system is disclosed in U.S. Patent Number 5,136,647 issued to Stuart Harber and Wakefield Stornetta Jr. on August 4, 1992, directed to a system for time-stamping a digital document. The time stamping protects the secrecy of the document text and provides a tamper proof time scale establishing an author's claim to the temporal existence of the document. The objective is to incorporate the content of the document by utilizing a one-way hash function and a time stamp into the digital data itself so that it is not possible to change any bit of the resulting time-stamp data without such a change being apparent. The author of the document does not generate the time stamping, instead the services of an independent agent are used for time stamping. A digital signature procedure is also employed by the independent agent to deter the incorporation of a false time statement. The system is primarily directed to address the need to establish the date on which a document was created and to prove that the text of a document in question is in fact is same as that of the original dated document. The system enables the detection of any alteration of the content of the digital document by examining the hash function, the time stamp and digital signature associated with the document.

Another prior art system, disclosed in U.S. Patent Number 5,150407 issued to Steve Chan on September 22, 1992, is directed to a secured data storage device including a secured portion and a medium portion. The secured portion is a physically secured enclosure with very limited access from outside sources. The medium portion includes a conventional storage medium such as a hard disk or a floppy disk. In this system, data encoding is accomplished by utilizing an encryption algorithm and the associated key is separated into two parts, wherein the first part is stored in the secured portion of the storage device and the second part is stored in the medium portion of the storage device. This system also uses a time stamping procedure along with the encryption of the data without using an independent agent.

A further prior art system, disclosed in U.S. Patent Number 5,289,540 issued to Richard Jones on February 22, 1994, is directed to a computer file protection system. The system includes both hardware and software elements and the protection process operates by intercepting the file system data path between a central processing unit and a file storage or memory device. The system also includes a programmable auxiliary memory and auxiliary control unit.

Another prior art system, disclosed in U.S. Patent Number 5,619,571 issued to Brent Sandstorm, et al., on April 8, 1997, is directed to a system for

securely storing electronic records. In this system, a data stream image identification code and time data provided by a trusted source are combined to generate a key. The image identification code and time data are stored in a public directory and a verification code is generated from the data stream. This verification code is placed in a private area that is encrypted by the key generated by the method described earlier.

Another prior art system, disclosed in U.S. Patent Number 5,623,546 issued to Douglas Hardy, et al., on April 22, 1997, is directed to an encryption method and system for portable data, wherein portable encrypted data can be accessed through multiple hosts. A split key encryption system encrypts data and stores that data on a portable device. One split of the portable key is stored in the portable device, and another split of the key is stored in the home host.

However, the above conventional systems do not address the problem of securing the stored data from intruder access, require special hardware for the secured portion of the storage device and do not support a client-server architecture.

SUMMARY OF THE INVENTION

The present invention provides a method and system for securely storing data locally or in a central facility such that only properly authorized and authenticated persons can retrieve such stored data. For example, users may use one embodiment of the present invention to store data in encrypted form by executing a save as encrypted command. Once the date is encrypted it may be decrypted and retrieved by executing a retrieve data command. The present invention provides a way to preserve the integrity and authenticity of the stored data such that no unauthorized alteration to the content of the data or the time at which the data was originally generated takes place. The present invention generates a record of the history of the data storage and retrieval operations to facilitate auditing functions for use of such data.

In one embodiment, the present invention provides a method for authorized users to securely store and retrieve data files in a network system, whereby a user can encode data for storage and later retrieve and decrypt the data for use. The network system comprises a server computer system interconnected to a client computer system via a communication link. The method of securing access to data comprises generating identifying information that represents the data at the client computer system. The identifying information may be transmitted to the server computer system when an event occurs. The computer system receives the identifying information and utilizes it to generate a key pair corresponding to the identifying information. The key

pair typically includes an encode key and a decode key for encoding and decoding of the data. In one or more embodiments of the invention the server computer system stores the key pair and the identifying information for later use. The server may then transmit the encode key to the client computer system. When the client computer system receives the encode key it utilizes it to encode the data. The invention also contemplates transmitting the decode key to the client computer system upon requests.

Secure Save:

In one example implementation the client and server computer systems interact with one another. For example, the client computer system may generate a client message file comprising information that represents the data. The client message file is transmitted to the server computer system; and utilized to generate a key pair including an encode key for encoding the data and a decode key for decoding the encoded data. The server computer then stores the key pair and information from the client message file. In one or more embodiments of the invention the server generates a server message file that comprises the encode key and transmits the server message file to the client computer system. The client computer system may then encode data using the encode key in the server message file. Once the data is encoded it is stored for later use.

Retrieve Data:

Thereafter, to provide access to encoded data, the client and server computer systems continue to interact. For example, the client computer generates a client message file. The client message file may comprise information representing the data that is to be stored. The client message file is transmitted to the server computer and utilized by the server to retrieve information including a decode key for decoding the encoded data. One embodiment of the invention contemplates generating a server message file including the decode key, and transmitting the server message file to the client computer system. When the client computer receives the server message it accesses the encoded data, and may decode the data using the decode key in the server message file.

The client and server message files can further include time stamps and authentication information for the data. As such, the integrity and authenticity of the stored data are preserved wherein no unauthorized alteration to the content of the data or the time at which the data was originally generated takes place. Further, using the time stamp information, a record of the history of the data storage and retrieval operations can be generated to facilitate auditing functions for use of such data.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other features, aspects and advantages of the present invention will become better understood with regard to the following description, appended claims and accompanying drawings where:

Figure 1 shows an example block diagram of a network system in which the present invention can be implemented;

Figure 2 shows example block diagram of client and server computer systems of Figure 1 configured by software;

Figure 3 shows a block diagram of an example server computer of Figure 1;

Figure 4 shows details of an embodiment of a transaction server in the server computer of Figure 3;

Figure 5 shows an example flow diagram of registration/authentication steps for secure save/retrieve operations on the system of Figure 1 according to the present invention;

Figures 6-7 show an example flow diagram of an embodiment of secure save of a data file on the system of Figure 1 according to the present invention; and

Figures 8-9 show an example flow diagram of an embodiment of secure retrieve of a data file on the system of Figure 1 according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

In one embodiment, the present invention provides a system for secure real time storage and retrieval of data by a first computer with the aid of a second computer via communication link between the first and second computers. In one or more embodiments of the invention, the communication link is secure. However the invention also contemplates the use of insecure communication links. The system enables a user at the remote first computer to secure a data file for storage by connecting to the second computer and by exchanging certain parameters between the two computers. The system also enables the user at the first computer to retrieve the stored secure data file by connecting to the second computer and by exchanging certain parameters between the two computers.

In one embodiment, the present invention comprises: (1) a secure data storage and retrieval module that can be downloaded to the first computer from the second computer by the first computer and executed on the first computer, and (2) an enabling module that may be executed on the second computer while the first and the second computers maintain a communication link to one another. Communication between the first computer and second computer may utilize data encryption to preserve the security and integrity of the data transferred between the two computers. The user utilizes the first computer to register with the second computer and establish a personal identity (e.g. a password). Once an identity is established, the user is then able to secure

and store a data file by executing a secure save command that is made available by the secure data storage and retrieval module residing at the first computer.

Secure Save Command:

After initiating the secure save command, the first computer transmits the file name, an identification parameter of the first computer and the personal identification information to the second computer. The second computer, after processing the received information and after proper authentication of the first computer, generates a time stamp, a digital signature that is a function of the time, the file name, the identification parameter and the password, and a key pair including both encryption and decryption keys. The second computer stores such received and generated information in its database and transmits the file name, the time stamp, the digital signature and the encryption key to the first computer. The first computer encrypts the data file using the received encryption key and stores the encrypted data file along with the time stamp and the digital signature using the file name.

Retrieve Data Command:

Thereafter, the user can retrieve the data file from secure storage by using a retrieve data command made available in the secure data storage and retrieval module in the first computer. By initiating the retrieve data command, the first computer transmits the file name, the identification parameter of the

first computer, and the personal identification information (e.g. password) along with the time stamp and the digital signature to the second computer. The second computer, after processing the received parameters retrieves the stored data from its database and compares the data with the received data. After proper validation, the second computer transmits the file name and the decryption key to the first computer. The first computer may then access and decrypt the encrypted data file using the decryption key.

Figure 1 shows a block diagram of an example embodiment of a network 100 including one or more client computer systems 101 interconnected to one or more server computer systems 130, in which the present invention can be implemented. Computer system 101 includes a bus 102 or other communication mechanism for communicating information, and a processor (CPU) 104 coupled with the bus 102 for processing information. Computer system 101 also includes a main memory 106, such as a random access memory (RAM) or other dynamic storage device, coupled to the bus 102 for storing information add instructions to be executed by the processor 104. The main memory 106 also may be used for storing temporary variables or other intermediate information during execution or instructions to be executed by the processor 104.

The computer system 101 further includes a read only memory (ROM) 108 or other static storage device coupled to the bus 102 for storing static

information and instructions for the processor 104. A storage device 110, such as a magnetic disk or optical disk, is provided and coupled to the bus 102 for storing information and instructions. The bus 102 may contain, for example, thirty-two address lines for addressing video memory or main memory 106. The bus 102 can also include, for example, a 32-bit data bus for transferring data between and among the components, such as the CPU 104, the main memory 106, video memory and the storage 110. Alternatively, multiplex data / address lines may be used instead of separate data and address lines.

In one embodiment, the CPU 104 comprises a microprocessor manufactured by Motorola(R), such as the 680x0 processor or a microprocessor manufactured by Intel(R), such as the 80X86, or Pentium(R) processor, or a SPARC(R) microprocessor from Sun Microsystems(R). However, any other suitable microprocessor or microcomputer may be utilized. The main memory 106 can comprise dynamic random access memory (DRAM). And video memory (not shown) can comprise a dual-ported video random access memory.

The computer system 101 may be coupled via the bus 102 to a display 112, such as a cathode ray tube (CRT), for displaying information to a computer user. An input device 114, including alphanumeric and other keys, is coupled to the bus 102 for communicating information and command selections to the processor 104. Another type or user input device comprises cursor control 116,

such as a mouse, a trackball, or cursor direction keys for communicating direction information and command selections to the processor 104 and for controlling cursor movement on the display 112. This input device typically has two degrees of freedom in two axes, a first axis (e.g., x) and a second axis (e.g., y) that allows the device to specify positions in a plane.

According to one embodiment of the invention, the steps of the processes of the present invention is provided by the computer system 101 in response to the processor 104 executing one or more sequences of one or more instructions contained in the main memory 106. Such instructions may be read into the main memory 106 from another computer-readable medium, such as the storage device 110. Execution of the sequences of instructions contained in the main memory 106 causes the processor 104 to perform the process steps described herein. One or more processors in a multi-processing arrangement may also execute the sequences of instructions contained in the main memory 106. In one embodiment of the invention, hard-wired circuitry may be used in place of or in combination with software instructions to implement the invention. Thus, embodiments of the invention are not limited to any specific combination of hardware circuitry and software.

The term computer-readable medium as used herein refers to any medium that participated in providing instructions to the processor 104 for execution. Such a medium may take many forms, including but not limited to,

non-volatile media, volatile media, and transmission media. Non-volatile media includes, for example, optical or magnetic disks, such as the storage device 110. Volatile media includes dynamic memory, such as the main memory 106. Transmission media includes coaxial cables, copper wire and fiber optics, including the wires that comprise the bus 102. Transmission media can also take the form of acoustic or light waves, such as those generated during radio wave and infrared data communications.

Common forms of computer-readable media include, for example, a floppy disk, a flexible disk, hard disk, magnetic tape, or any other magnetic medium, a CD-ROM, any other optical medium, punch cards, paper tape, any other physical medium with patterns of holes, a RAM, a PROM, an EPROM, a FLASH-EPROM, any other memory chip or cartridge, a carrier wave as described hereinafter, or any other medium from which a computer can read.

Various forms of computer readable media may be involved in carrying one or more sequences of one or more instructions to the processor 104 for execution. For example, the instructions may initially be carried on a magnetic disk of a remote computer. The remote computer can load the instructions into its dynamic memory and send the instructions over a telephone line using a modem. A modem local to the computer system 101 can receive the data on the telephone line and use an infrared transmitter to convert the data to an infrared signal. An infrared detector coupled to the bus 102 can receive the data

carried in the infrared signal and place the data on the bus 102. The bus 102 carries the data to the main memory 106, from which the processor 104 retrieves and executes the instructions. The instructions received from the main memory 106 may optionally be stored on the storage device 110 either before or after execution by the processor 104.

The computer system 101 also includes a communication interface 118 coupled to bus the 102. The communication interface 118 provides a two-way data communication coupling to a network link 120 that is connected to a local network 122. For example, the communication interface 118 may be an integrated services digital network (ISDN) card or a modern to provide a data communication connection to a corresponding type of telephone line, which can comprise part of the network link 120. As another example, the communication interface 118 may be a local area network (LAN) card to provide a data communication connection to a compatible LAN. Wireless links may also be implemented. In any such implementation, the communication interface 118 sends and receives electrical electromagnetic or optical signals that carry digital data streams representing various types of information.

The network link 120 typically provides data communication through one or more networks to other data devices. For example, the network link 120 may provide a connection through the local network 122 to a host computer 124 or to data equipment operated by an Internet Service Provider

(ISP) 126. The ISP 126 in turn provides data communication services through the world wide packet data communication network now commonly referred to as the Internet 128. The local network 122 and the Internet 128 both use electrical, electromagnetic or optical signals that carry digital data streams. The signals through the various networks and the signals on the network link 120 and through the communication interface 118, which carry the digital data to and from the computer system 101, are exemplary forms or carrier waves transporting the information.

The computer system 101 can send messages and receive data, including program code, through the network(s), the network link 120 and the communication interface 118. In the Internet example, a server 130 might transmit a requested code for an application program through the Internet 128, the ISP 126, the local network 122 and the communication interface 118. Each of the servers 130 can comprise one or more computer systems such as the computer systems 101 therein.

The communication interface 118 can comprise a USB/Tuner and the network link 120 may be an antenna or cable for connecting the computer system 101 to a cable provider, satellite provider or other terrestrial transmission system for receiving messages, data and program code from another source.

The received code may be executed by the processor 104 as it is received, and/or stored in the storage device 110, or other non-volatile storage for later execution. In this manner, the computer system 101 may obtain application code in the form of a carrier wave.

The example versions of the invention described herein are implemented as logical operations in a distributed processing system such as the network system 100 including client and server computing systems 101 and 130, respectively. The logical operations of the present invention can be implemented as a sequence of steps executing on the computing network 100, and as interconnected machine modules within the computing network 100. The implementation is a matter of choice and can depend on performance of the network 100 implementing the invention. As such, the logical operations constituting said example versions of the invention are referred to for e.g. as operations, steps or modules.

In one or more embodiments of the invention the communication link between a client computer system 101 and a server 130 comprises a secure communication medium. For example, in one embodiment the present invention is directed to a secure real time data storage and retrieval system comprising the client-server architecture of the network 100 (Figure 1), wherein a secured communication medium is maintained between the client computer 101 and the server computer 130. A user at the client computer 101 is provided

with functions including secure data storage and data retrieval, wherein enabling functions are performed on the server computer 130 while the client computer 101 and the server computer 130 maintain a secure communication link to one another.

Security and authenticity of the information communicated among the computer systems 101, 130 can be maintained using different authentication protocols. In one example wherein the communication medium comprises the Internet, security for information exchanged over the Internet is accomplished utilizing a software layer such as built in features of the known secure sockets layer (SSL) Internet communication protocol. A cryptographic hardware device can also be incorporated in the server computer system 130 to ensure authenticity and security of the information exchanged between the client computer 101 and the server computer 130.

To provide secure access to data, the server computer includes a secure data storage and retrieval ("SM") module for execution on the client computer 101, and an enabling module ("EM") for execution on the server computer 130. In one or more embodiments of the invention the SM module and EM module comprise computer program code. However, the SM module and EM module may also be embodied into hardware devices configured to implement the logic of each module. Referring to Figure 2, the SM module is downloaded from the server computer 130 to the client computer 101, and the EM module is

simultaneously executed on the server computer 130 while maintaining a secure communication link between the client computer 101 and the server computer 130. The computer system 101 can include a user interface such as graphical user interface ("GUI") or user interaction, and upon execution the SM module presents command, control and information displays to a user utilizing the GUI. For example, the SM module may present command buttons to a user on a tool bar in the GUI, whereby the user can utilize a SAVE command button to achieve secure storage of a data file and a RETRIEVE command for retrieving the stored data file. As such, the execution of the SM and EM module can be virtually transparent to a user at the client computer 101.

Referring to Figure 3, the server system 130 can comprise a private network 132 and a public network 134 connected to the Internet and to each other via a firewall system 136 for protection. The firewall and the public network prevent direct access to the private network via an Internet connection. As such, the server computer 130 permits communication with a client computer 101 only if information packets transmitted by the client system 101 complies with the security policy protocol at the server system 130.

The public network comprises a transaction server 138 and the private network comprises a database server 140. The database server can only be accessed from the transaction server through the firewall. The database server is primarily used for storage of information and data files. Both the transaction

server and the database server can comprise redundant backup servers to circumvent emergency interruptions in their operation. Referring to Figure 4, a cryptographic device 142 that meets the certification requirements of Federal Information Processing Standards (FIPS) Publication 140-1 security levels for processing sensitive information can be incorporated into the transaction server 138. In one embodiment of the invention the cryptographic device is employed to generate an encode (e.g., encryption) key, a decode (e.g., decryption) key and a digital signature pertaining to a particular data file to be stored and retrieved.

Referring to the flow diagram in Figure 5 of an example registration/authentication process according to one embodiment of the present invention, after download and installation of the SM module in the client computer 101, the SM module prompts the user through a registration process with the computer server 130 (step 200). During the registration process the user may select and enter an identify (e.g. a password) into client computer 101 (step 202), and the client SM module transmits a message comprising the identity (password) to the EM module residing at server computer 130. In one or more embodiments of the invention the message is transmitted to the EM module in encrypted form (e.g. Data Encryption Standard (DES)). (step 204). Then the SM module transmits a message comprising a challenge (e.g. a 64-bit random number) to the EM module (step 206).

Using cryptographic device 142, the EM module digitally signs the challenge using a private key associated with the EM module software (step 208). The SM module uses a corresponding public key of EM module to verify the digital signature of the server message (step 210). If the signature is valid (step 212), then the authentication process has been successfully completed (step 211), otherwise the user is prompted with an appropriate message (step 209). A user must typically register with server 130 only once and thereafter the user can use system 100 for secure storage and retrieval of data files.

Secure Data Save Process:

Referring to the flow diagrams in Figures 6-7 an example secure data save process according to one embodiment of the present invention is shown. Upon successful authentication and registration, the present invention provides a mechanism to securely store a data file. The user initiates a secure save by clicking the secure SAVE command option on the toolbar created by the installation of the SM module at the client computer 101 (step 220). However, other events such as the occurrence of certain criteria (e.g. passing of time) may also imitate a secure save command. This establishes a secure communication session between the SM module in the client computer 101 and the EM module in the server computer 130 (step 222), and a query to the user for entering the user's personalized identity selected as aforementioned (step 224). If a proper identity is entered (step 226), the secure communication session begins,

transparent to the user. Otherwise, if the entered identity is in error the session ends with an appropriate error message to the user (step 228).

After the secure communication link is established between the client computer 101 and the server computer 130, the SM module generates a one way hash function of the data that is to be stored. Then the SM module creates a client message file comprising the hash function, the data file name and an identification number of the SM module (step 228) and transmits the client message file to the server computer 130 (step 230). After processing the received client message file, the EM module at the server computer 130 generates a time stamp, a digital signature reflecting the digital time stamp and the hash function, and a key pair including an encryption key and a decryption key for encryption and decryption of the data file (step 232). The EM module then stores information comprising the user identification number, data file name, hash function, time stamp, digital signature, the encryption key and the decryption key as a data record in a server database (step 234). The data can be stored at server computer 130, or the data may be stored on another computer accessible via a computer network, or elsewhere. The EM module then generates a server message file including the data file name, time stamp, digital signature and the encryption key, and transmits the server message file to the client computer 101 (step 236).

Referring to the flow diagram in Figure 7, upon receiving the server message file, the SM module at the client computer 101 saves the information in the received message file (step 238), accesses the data (step 240) and utilizes the encryption key in that message file to encrypt the data (step 242) and stores the encrypted data file along with the time stamp and the digital signature by using the file name (step 244). The encrypted data file and related information can be stored in a storage device at the client computer 101 or elsewhere in the network 100 (e.g. another computer).

Data Retrieve Process:

Referring to flow diagrams of Figures 8-9 of an example secure data retrieve process according to one or more embodiments of the present invention. When the user is ready to retrieve the stored encoded data file, the user initiates a secure data retrieve by clicking the secure RETRIEVE data command button in the toolbar created by the installation of the SM module at the client computer 101 (step 300). The secure RETRIEVE may also be initiated by the occurrence of an event such as the passing of time. The secure RETRIEVE command initiates a secure communication session between the SM module residing at the client computer 101 and the EM module residing at the server computer 130 (step 302), and a query to the user for entering the user's personalized identity into the client computer 101 (step 304). The present invention also contemplates the automatic entry of personalized identity information. For example, if the user was authenticated in an earlier session the identity information from that session may be utilized. Once the proper

identity is entered, the secure communication session begins, transparent to the user (step 306). Otherwise, if the entered identity is in error, the session ends with an appropriate error message to the user (step 308).

After the secure communication link is established between the client computer 101 and the server computer 100, the SM module creates a client message file comprising the data file name, the digital signature and the identification number (step 310) and transmits the client message file to server computer 140 (step 312). After processing the received client message file, the EM module retrieves the corresponding data record from the server database (step 314) for verification of the received digital signature associated with the data file name (step 316). If the verification fails, the communication terminates with an appropriate error message to the user to the user step (318).

Referring to Figure 9, after proper verification and validation, the EM module generates a data retrieval time stamp, otherwise the EM module generates an attempted data retrieval time stamp (step 320). The EM module then stores such time information in the server database in the data record corresponding to the data file to facilitate the generation of a time history of storage and retrieval of data by the client computer 101 for subsequent audit purposes (step 322). Further, the EM module creates a server message file including the data file name and the decryption key (step 324), and transmits the server message file to the client computer 101 (step 326).

After receiving the server message file, the SM module in the client computer 101 accesses the stored encrypted data file (step 328) and uses the decryption key in the server message file to decrypt data file (step 330). The data in the data file is then ready for further use. For each storage and retrieval operation a unique key pair is used and this key pair is not used in any subsequent storage or retrieval functions.

As such, according to the present invention, data can be stored or retrieved in a secure manner by using an authentication procedure utilizing a client-server architecture. Further, the integrity of the stored data, including the time of storage of the data, can be maintained by the use of cryptography. And, a time history of storage and retrieval of data operations can be made available for subsequent auditing purposes.

Although the present invention has been described in considerable detail, other versions are possible. Therefore, the appended claims should not be limited to the descriptions of the versions contained herein.

CLAIMS

What is claimed is:

1. In a computer system, a method for securing access to data, comprising:

generating a first message at a first computer system, said first message comprising information corresponding to data, and transmitting said first message to a second computer system;

receiving said first message at said second computer system, and generating a key pair comprising an encode key and a decode key for encoding and decoding of said data;

generating a second message comprising the encode key, and transmitting said second message to said first computer system; and

receiving said second message at said first computer system, wherein said encode key in the second message can be used to encode said data.

2. The method of claim 1 further comprising:

storing said key pair and said information in said first message in a record;

3. The method of claim 1, further comprising encoding said data using said encode key, and storing said encoded data.

4. The method of claim 1, wherein said first computer system comprises at least one client computer system and said second computer system comprises at least one server computer system.

5. The method of claim 1, wherein said step of generating said first message further comprises:

generating a one way hash function of said data; and

placing said hash function, information identifying said data, and user information for a user of said data at said first computer system in said first message.

6. The method of claim 5, further comprising:

obtaining said first message at said second computer; generating a time stamp, and a digital signature representing said digital time stamp and said hash function in said first message; and storing said user information, said information identifying said data, hash function, said time stamp and said digital signature in said record.

7. The method of claim 6 wherein said second message further comprises:

said time stamp, said information identifying said data, and said digital signature in said second message.

8. The method of claim 1, further comprising:

providing access to encoded data by performing steps comprising:

generating a third message at said first computer system, said third message comprising information corresponding to said encoded data, and transmitting said third message to said second computer system;

receiving said third message at said second computer system, and using said information in said third message to retrieve a record corresponding to said encoded data, said record including a decode key for decoding said encoded data;

generating a fourth message comprising said decode key, and transmitting said fourth message to said first computer system;

receiving said fourth message at said first computer system, wherein said decode key in said fourth message can be utilized to decode said encoded data.

9. The method of claim 8, further comprising;

accessing said encoded data and decoding said encoded data using said decode key.

10. The method of claim 8, wherein said third message further comprises:

said information identifying said encoded data, said user information, and said digital signature.

11. The method of claim 10, further comprising:

receiving said third message at said second computer system;

accessing said corresponding record; and

verifying said digital signature therein with said received digital signature.

12. The method of claim 11, further comprising:

upon proper verification, generating a fourth message comprising information identifying said encoded data file and said decode key, and transmitting said fourth message to said first computer.

13. The method of claim 12, further comprising:

receiving the fourth message at the first computer;

accessing the encoded data;

and using said decode key in said fourth message to decode said encoded data.

14. The method of claim 11, further comprising:

upon successful verification, generating a data retrieval time stamp and storing said data retrieval time stamp in a corresponding record.

15. The method of claim 14, further comprising:

upon unsuccessful verification, generating an attempted data retrieval time stamp and storing said attempted data retrieval time stamp in said corresponding record.

16. In a network system a method of providing access to encoded data, comprising:

generating a first message at a first computer system, said first message comprising information corresponding to said encoded data, and transmitting said first message to a second computer system;

receiving said first message at said second computer system, and using said information in said first message to retrieve a record corresponding to said encoded data, said record comprising a decode key for decoding said encoded data;

generating a second message comprising said decode key, and transmitting said second message to said first computer system;

receiving said second message at said first computer system, wherein said decode key in said second message can be utilized to decode said encoded data.

17. The method of claim 16 further comprising;

accessing said encoded data and decoding said encoded data using said decode key.

18. The method of claim 16 wherein said first computer system comprises at least one client computer system and said second computer system comprises at least one server computer system.

19. A system for securing access to data, comprising a first computer system interconnected to a second computer system via a communication link, wherein said first and said second computer systems are configured to perform steps comprising:

generating a first message at said first computer system, said first message comprising information corresponding to said data, and transmitting said first message to said second computer system;

receiving said first message at said second computer system, and generating a key pair comprising an encode key and a decode key for encoding and decoding of said data;

storing said decode key in a record;

generating a second message comprising said encode key, and transmitting said second message to said first computer system; and

receiving said second message at said first computer system, wherein said encode key in said second message can be used to encode said data to secure access to said data.

20. The system of claim 19, wherein said first computer is further configured to use said encode key to encode said data, and store said encoded data.

21. The system of claim 19, wherein said first and said second computer systems are further configured for providing access to encoded data by performing steps comprising:

generating a third message at said first computer system, said third message including information corresponding to said encoded data, and transmitting said third message to second computer system;

receiving said third message at said second computer system, and using said information in said third message to retrieve a record corresponding to said encoded data, said record including a decode key for decoding said encoded data;

generating a fourth message comprising said decode key, and transmitting said fourth message to said first computer system;

receiving said fourth message at said first computer system, wherein said decode key in said fourth message can be utilized to decode said encoded data.

22. The system of claim 21, wherein said first computer is further configured to access said encode data and use said decode key to decode said encoded data.

ABSTRACT OF THE INVENTION

A method and system for secure real time storage and retrieval of data by a first computer with the aid of a second computer via a secure communication link between the first and second computers. The method and system enable a user at the remote first computer to secure a data file for storage by connecting to the second computer and by exchanging certain parameters between the two computers. The method and system also enable the user at the first computer to retrieve the stored secure data file by connecting to the second computer and by exchanging certain parameters between the two computers.

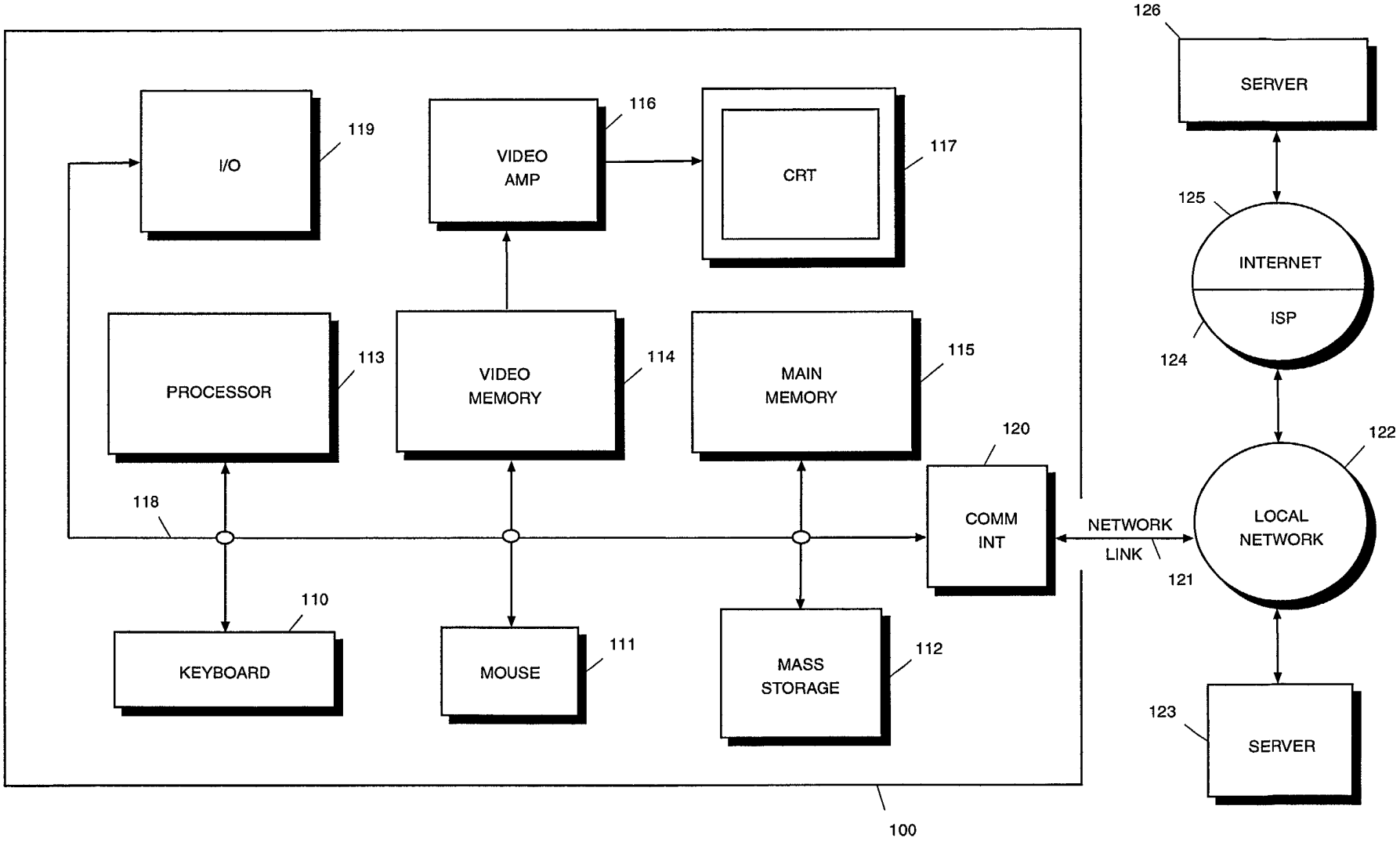


FIGURE 1

FIGURE 2

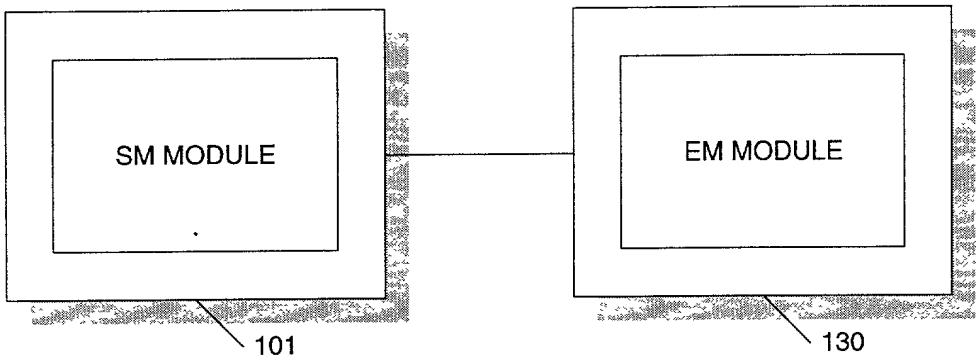


Figure 3

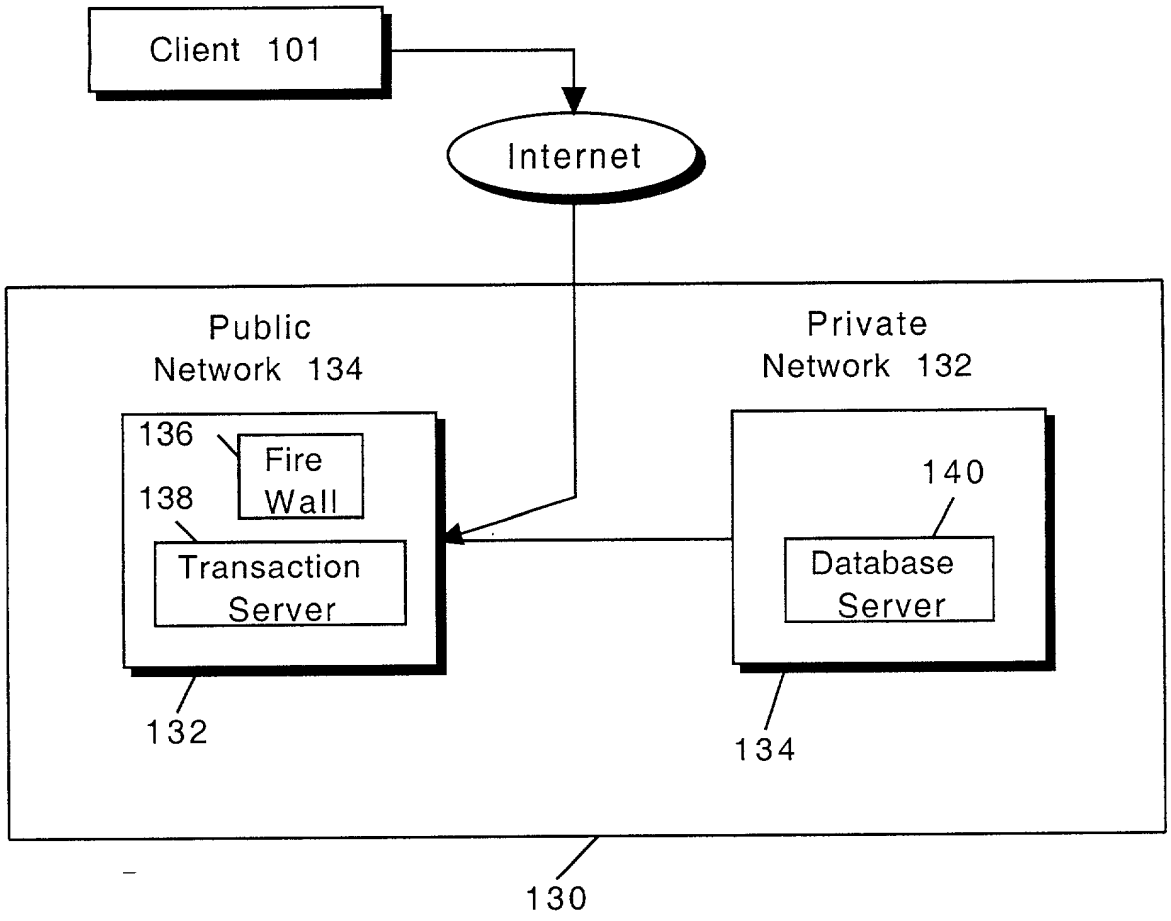
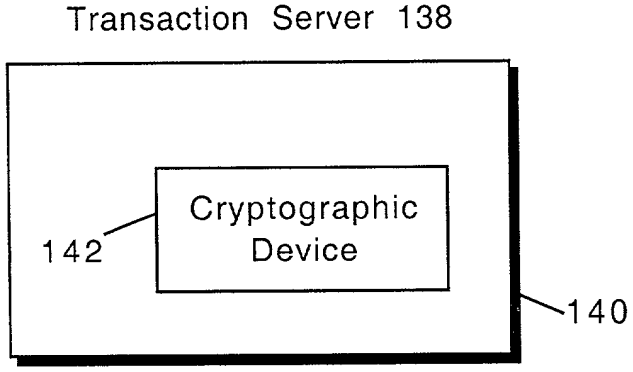


Figure 4



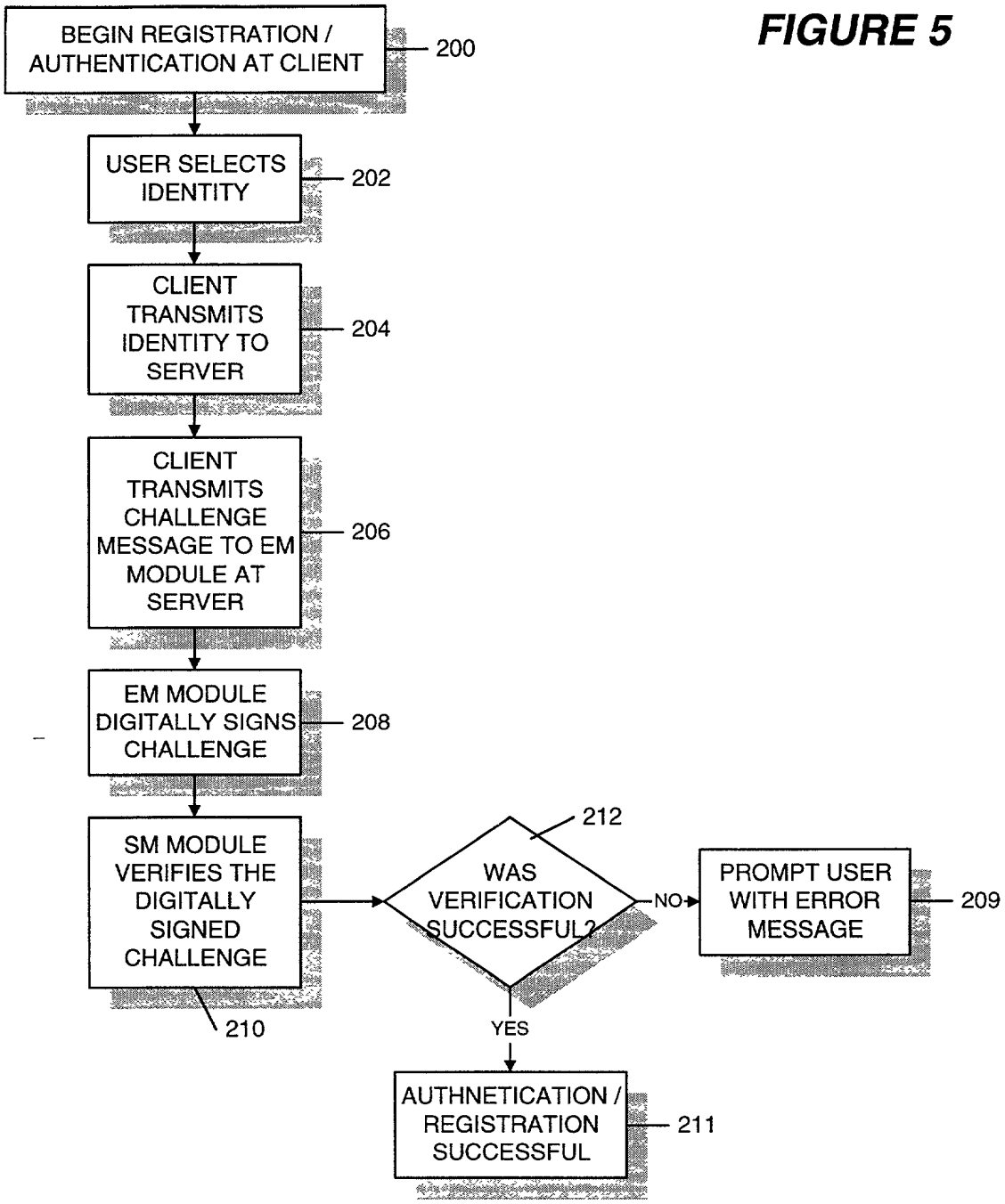

BEGIN REGISTRATION / AUTHENTICATION AT CLIENT
200
USER SELECTS IDENTITY
202
CLIENT TRANSMITS IDENTITY TO SERVER
204
CLIENT TRANSMITS CHALLENGE MESSAGE TO EM MODULE AT SERVER
206
EM MODULE DIGITALLY SIGNS CHALLENGE
208
SM MODULE VERIFIES THE DIGITALLY SIGNED CHALLENGE
210
212
WAS VERIFICATION SUCCESSFUL?
NO
PROMPT USER WITH ERROR MESSAGE
209
YES
AUTHNETICATION / REGISTRATION SUCCESSFUL
211

FIGURE 5

FIGURE 6

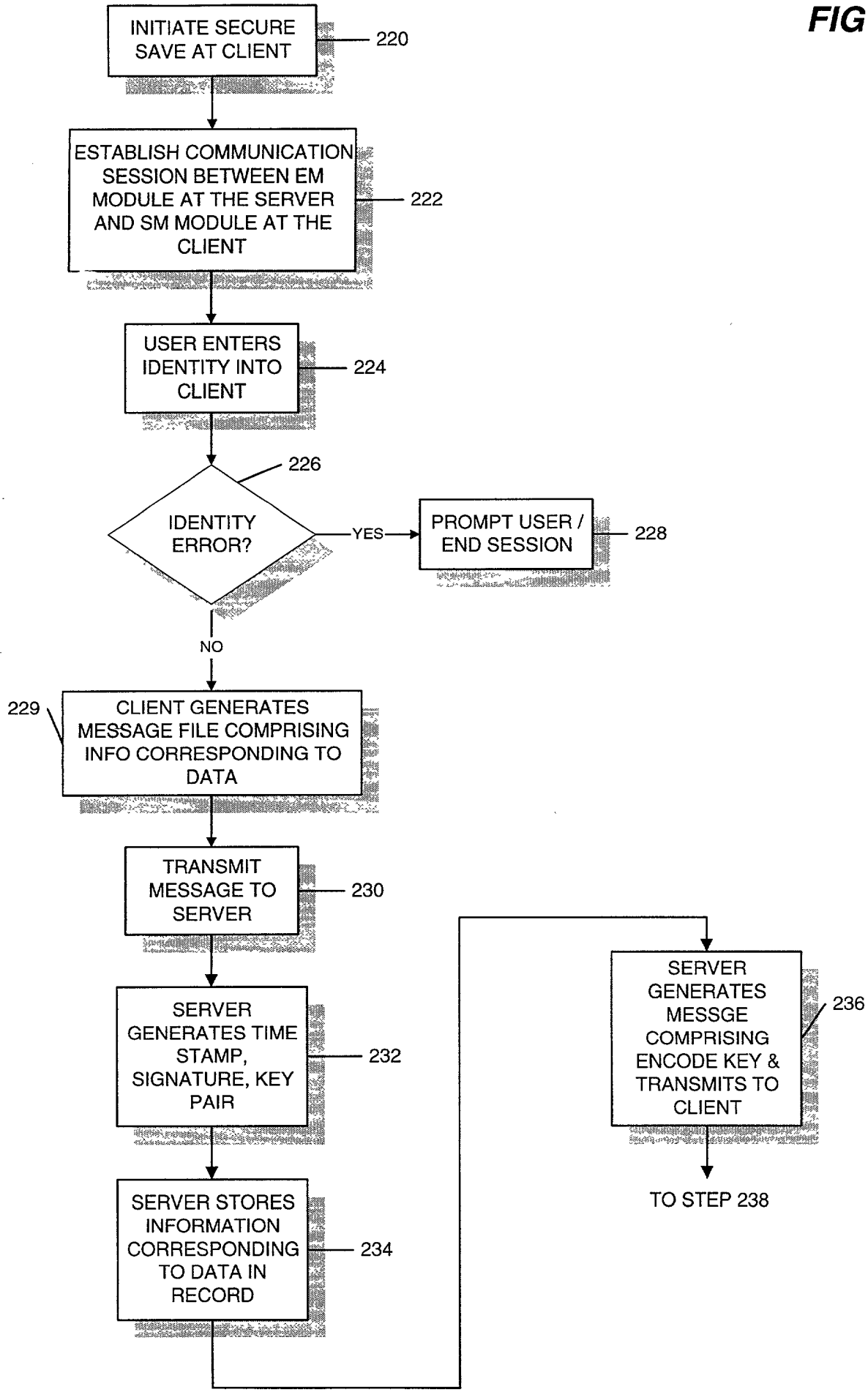

INITIATE SECURE SAVE AT CLIENT
220
ESTABLISH COMMUNICATION SESSION BETWEEN EM MODULE AT THE SERVER AND SM MODULE AT THE CLIENT
222
USER ENTERS IDENTITY INTO CLIENT
224
226
IDENTITY ERROR?
YES
PROMPT USER / END SESSION
228
NO
229
CLIENT GENERATES MESSAGE FILE COMPRISING INFO CORRESPONDING TO DATA
TRANSMIT MESSAGE TO SERVER
230
SERVER GENERATES TIME STAMP, SIGNATURE, KEY PAIR
232
SERVER STORES INFORMATION CORRESPONDING TO DATA IN RECORD
234
SERVER GENERATES MESSGE COMPRISING ENCODE KEY & TRANSMITS TO CLIENT
236
TO STEP 238

FIGURE 7

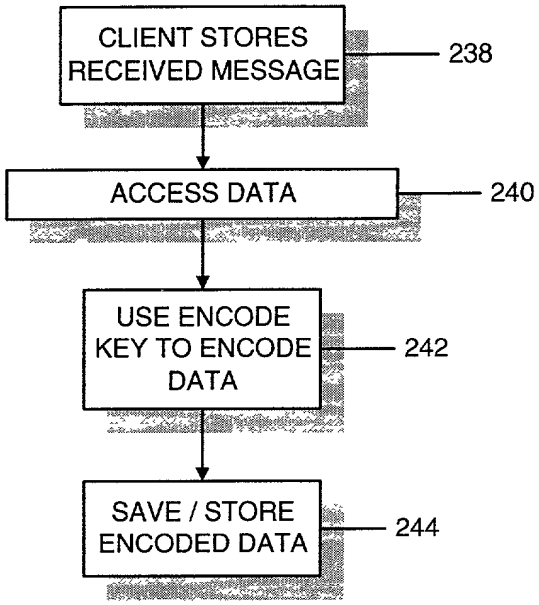

CLIENT STORES RECEIVED MESSAGE
238
ACCESS DATA
240
USE ENCODE KEY TO ENCODE DATA
242
SAVE / STORE ENCODED DATA
244

FIGURE 8

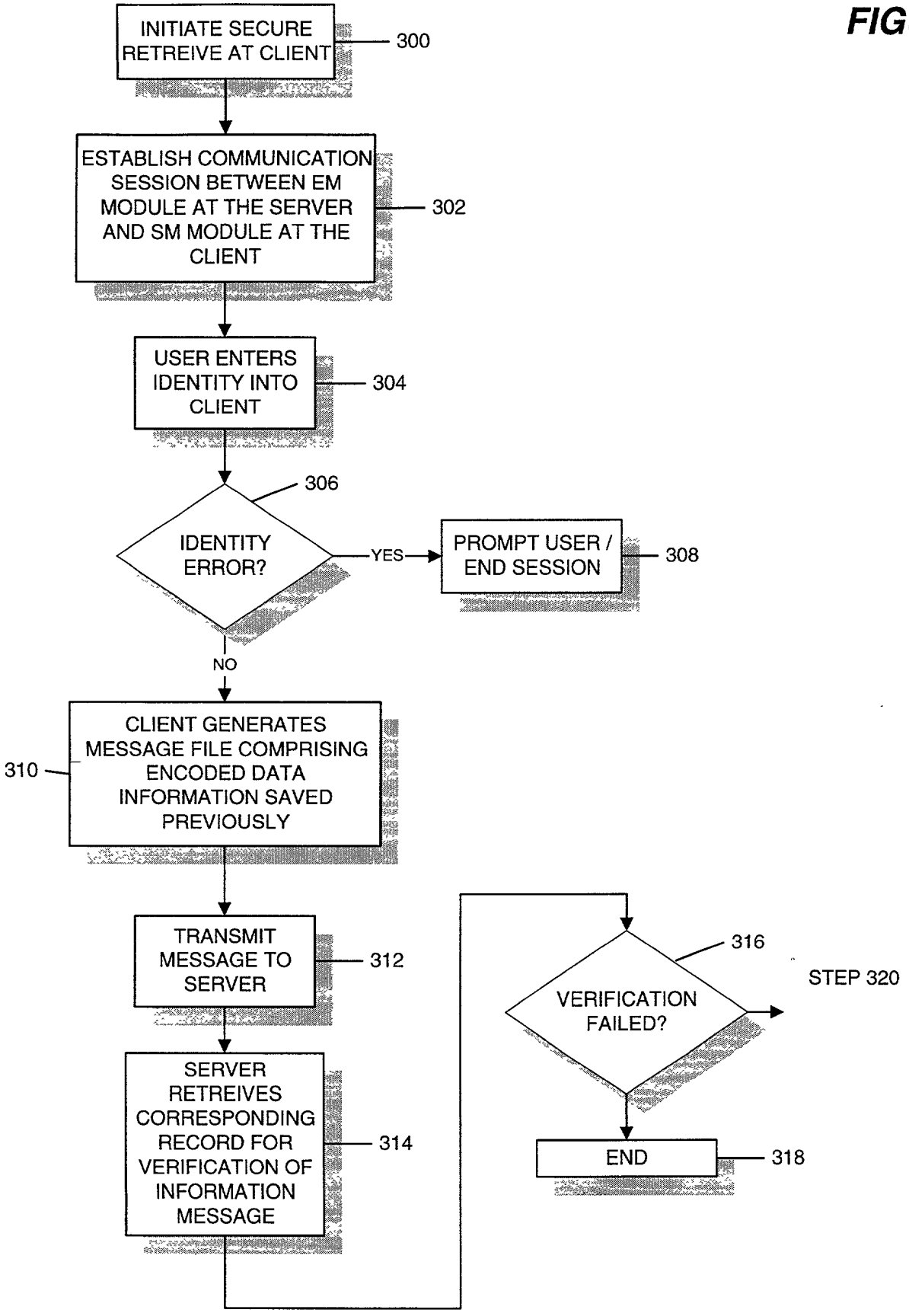
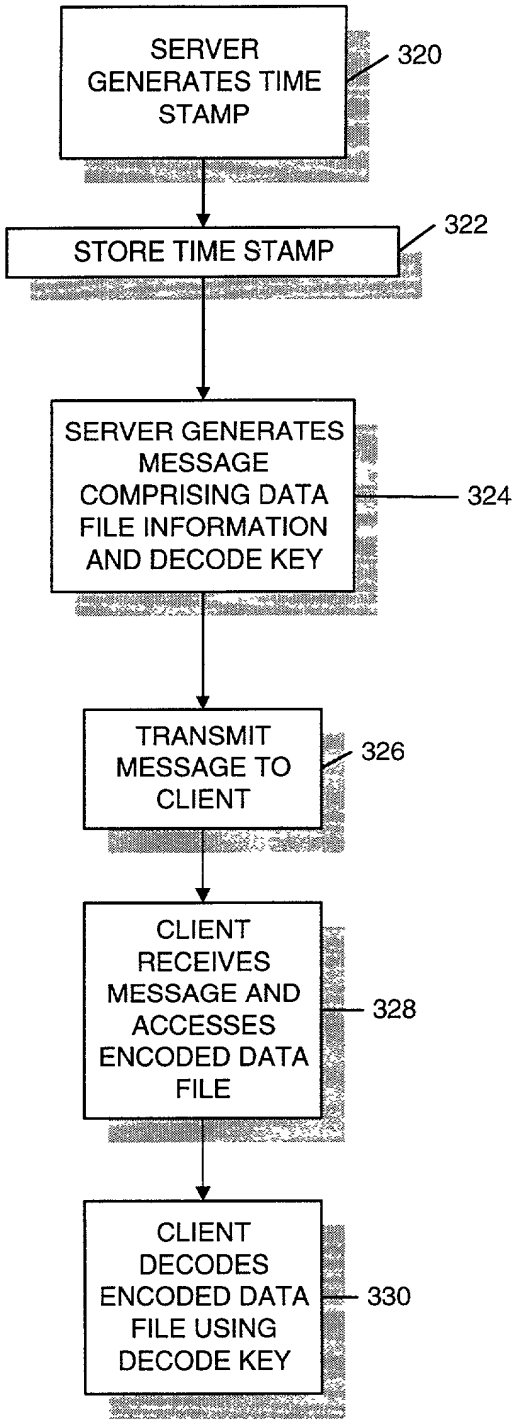

INITIATE SECURE RETREIVE AT CLIENT
300
ESTABLISH COMMUNICATION SESSION BETWEEN EM MODULE AT THE SERVER AND SM MODULE AT THE CLIENT
302
USER ENTERS IDENTITY INTO CLIENT
304
306
IDENTITY ERROR?
YES
PROMPT USER / END SESSION
308
NO
CLIENT GENERATES MESSAGE FILE COMPRISING ENCODED DATA INFORMATION SAVED PREVIOUSLY
310
TRANSMIT MESSAGE TO SERVER
312
SERVER RETREIVES CORRESPONDING RECORD FOR VERIFICATION OF INFORMATION MESSAGE
314
316
VERIFICATION FAILED?
STEP 320
END
318

FIGURE 9


SERVER GENERATES TIME STAMP
320
STORE TIME STAMP
322
SERVER GENERATES MESSAGE COMPRISING DATA FILE INFORMATION AND DECODE KEY
324
TRANSMIT MESSAGE TO CLIENT
326
CLIENT RECEIVES MESSAGE AND ACCESSES ENCODED DATA FILE
328
CLIENT DECODES ENCODED DATA FILE USING DECODE KEY
330